UCLA
Computer Science Department
Winter 2017

Student Name and ID: _____

CS144 Final: Closed Book, 2 hours

(IMPORTANT PLEASE READ **):**

- There are 7 problems on the exam to be completed in 2 hours. *You should look through the entire exam before getting started, in order to plan your strategy.*
- You may use two sheets of double-sided notes during exam. You are also allowed to use a calculator. Attach extra pages as needed. Write your name and ID on the extra pages.
- *Simplicity and clarity of your solutions will count.* You may get as few as 0 points for a problem if your solution is far more complicated than necessary, or if we cannot understand your solution.
- If you need to make any assumption to solve a question, please *write down your assumptions*. You may also want to write down how you arrived at your answer step by step to get partial credit.

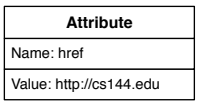
Problem	**Score**	
1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
Total	70	

Problem 1: 10 points

In the space provided below, draw the HTML DOM tree of the following HTML document according to the W3c standard:

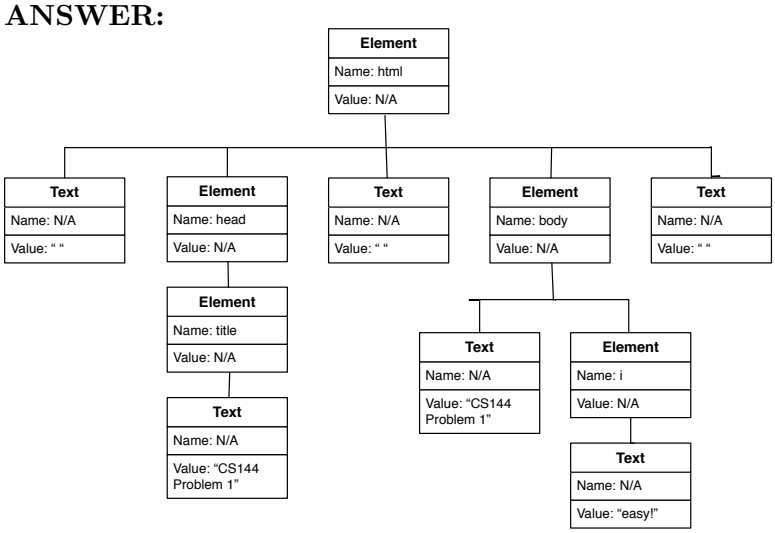
```
<!DOCTYPE html>
<html>
<head><title>CS144 Problem 1</title></head>
<body>This problem is <i>easy!</i></body>
</html>
```

In your answer, make sure to indicate the type, name, and value of each node of your tree like the following attribute node:



If a particular node does not have a type, name, or value associated with it, write down "N/A" for the relevant field.

ANSWER:



Problem 2: 10 points

You are in charge of designing a Piazza-like Web site, where users can post and answer questions. Your design team has decided to use an HTML form to implement a page that allows users to post their question "title" and "body." The user's input title should be named "title," and the question body should be named "body." When the user clicks on the "Post" button on the page, the user's input should be sent to the URL `http://qna.com/new_question`. In the space provided below, write down the HTML form element and its associated subelements that implement this design:

```
<form action="http://qna.com/new_question" method="POST">
<input type="text" name="title">
<input type="textarea" name="body">
<input type="submit" value="Post">
</form>
```

Problem 3: 10 points

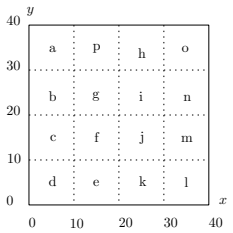
```
<!DOCTYPE html>
<html>
<head>
<style>
body: { padding: 30px; height: 100px }
.t1:  { margin: 10px; height: 50px }
.t2:  { margin: 20px; }
#b1:  { padding: 40px; }
</style>
<script>
function SetClass() {
   document.getElementById("b1").className = "t2";
}
</script>
</head>
<body class="t1" id="b1" onload="SetClass();">
This is the Problem 3 of CS144 Final Exam. Hopefully this is not too difficult.
</body>
</html>
```

The above HTML page is designed for devices with the screen size 1080px X 1920px. On such devices, what will be the width and height of the body text, once the page is fully loaded? Briefly explain your answer.

ANSWER:
Once the page is fully loaded, the body has class ‘‘t2’’ and id ‘‘b1’’. Therefore, the body’s padding is 40px, margin is 20px and height is 100px, which means that its width is $1080 - (40 \times 2 + 20 \times 2) = 960$px and its height is 100px.

Problem 4: 10 points

Consider the following GRID file for two-dimensional (x, y) database.



Every block in the grid file contains all points within its range, where points in the boundary will be stored to the block to the right (or above). For example the block f contains all points within $10 \leq x < 20$ and $10 \leq y < 20$.

Assume that we want to identify the nearest neighbor to the point $(16, 16)$ using the GRID file. After searching the block f, we learn that nearest point to $(16, 16)$ in f is $(13, 12)$. To find the *true* nearest neighbor, what other block(s) in the GRID file do we need to search as well?

ANSWER:
The distance between (16,16) and the closest point (13, 12) is $\sqrt{(16-13)^2 + (16-12)^2} = 5$. Since the distance between f and g is 4, which is smaller than 5 and the distance between f and j is 4 as well, we need to search these two blocks as well to ensure that there is no data point whose distance is smaller than 5 there.

Problem 5: 10 points

Consider the following Javascript code:

```
var x = 100;
function f(a) {
   var y = 0;
   return function () { return ++y * x + a; }
}

var f1 = f(10);
var a = f1();

var f2 = f(20);
var b = f2();

x = 200;
var c = f1();
var d = f2();
var e = f1();
```

At the end of the code, what will be the values of variables, `a`, `b`, `c`, `d`, and `e`?

ANSWER:

`a: 110, b: 120, c: 410, d: 420, e: 610`

Problem 6: 10 points

You are designing a database for online shopping Web site that carries 500,000 different products. The products are classified into one of three product categories, books, movies, and CDs. There are 300,000 books, 150,000 movies and 50,000 CDs. When users browse the Web site, they first select a particular product category that they are interested in and search for and look at products only within the selected category.

Each product is stored as a "tuple" in our database, and the size of each tuple is 1KB on average. A database installation on a single machine can store 1TB worth of tuples and can support up to 200 read (or write) requests per second.

At the peak of our site, 3,000 users concurrently access out Web site. Each user's activity on our Web site generates 1 database request every 10 seconds (the request can be either read or write). Among the 3,000 users at the peak, 60% are browsing the "books" category, 25% are browsing the "movies" category and 15% are browsing the "CDs" category. The database requests generated by the user activities are 60% reads and 40% writes within each category on average.

Given the above workload, answer the following questions

1. What is the minimum number of machine(s) you will need to support our database workload?

   ANSWER:
   `Our workload is 300 requests/sec.  Each machine can handle 200 requests/sec.`

2. What tuples will you store on which the machine(s)? How will you "split" and "replicate" our data among the machine(s)? If needed, you may refer to the "book" tuples as tuples b_1 through $b_{300,000}$, "movie" tuples as tuples m_1 through $m_{150,000}$, and "CD" tuples as c_1 through $c_{50,000}$.

   ANSWER:
   `On one machine, we will store all tuples for books.  On the other machine, we store all tuples for movies and CDs.`

Problem 7: 10 points

Voice-over-IP (VoIP) allows telephone calls to be carried over regular IP networks. Currently, most corporate VoIP installations use VoIP within an office building (or set of buildings) to connect telephones, but do not use the Internet to carry calls outside the company. For example, suppose that VoIP phones are used inside Boelter Hall, but all calls leaving the building are carried on an ordinary phone line. To bridge these two disparate network (Boelter Hall VoIP network and the ordinary phone line), a dedicated server "transforms" all VoIP calls placed from Boelter Hall into regular phone signals before the calls leave Boelter Hall network.

1. In organizations like UCLA, a person making a long distance call has to pay for the call in some way. Explain what requirements this places on the VoIP protocol. Choose from among these terms in writing your answer: confidentiality, authentication, integrity, authorization. Briefly explain how your choice(s) is/are relevant in this context.

   ANSWER:
   `Here we are not concerned about eavesdropping or communication integrity, we only need to ensure authentication and authorization.`

2. VoIP uses signaling protocols and media transport protocols. Signaling protocols are used to locate a user, set up a session, and close a session. Media transport protocols digitize voice input, allocate digital data to packets, and reassemble digitized voice signals. What kinds of steps you might use to protect VoIP calls within Boelter Hall from eavesdropping? Would you add cryptography to the signaling protocol or the media transport protocol to achieve this goal?

   ANSWER:
   `If we want to make sure that no communication can be eavesdropped, we need to encrypt the actual communication packet, but not necessarily the initial establishment of communication channel.`